Topics Covered

- Net Present Value
- Other Investment Criteria
- Mutually Exclusive Projects
- Capital Rationing

Net Present Value

Net Present Value - Present value of cash flows minus initial investments.

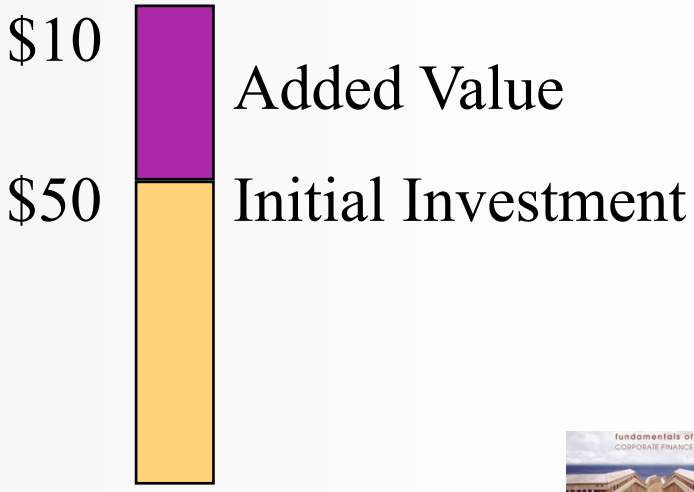
Opportunity Cost of Capital - Expected rate of return given up by investing in a project

Net Present Value

Example

Q: Suppose we can invest $50 today & receive $60 later today. What is our increase in value?

A: Profit = - $50 + $60
= $10



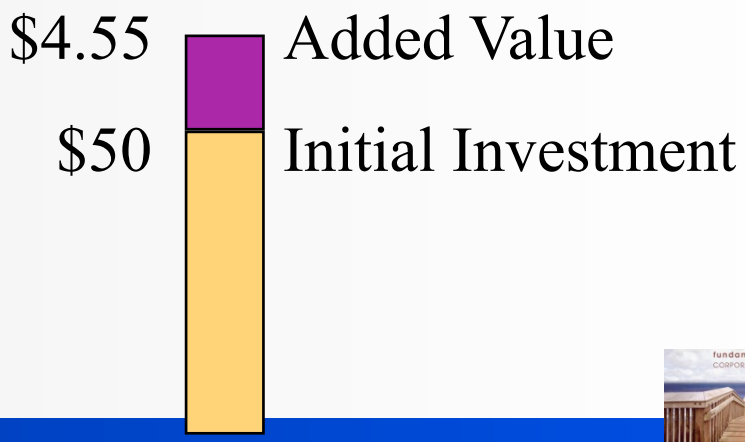
Net Present Value

Example

Suppose we can invest $50 today and receive $60 in one year. What is our increase in value given a 10% expected return?

$$\text{Profit} = -50 + \frac{60}{1.10} = \$4.55$$

This is the definition of NPV



Net Present Value

NPV = PV - required investment

$$NPV = C_0 + \frac{C_t}{(1+r)^t}$$

$$NPV = C_0 + \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_t}{(1+r)^t}$$

Net Present Value

Terminology

C = Cash Flow

t = time period of the investment

r = "opportunity cost of capital"

➲ The Cash Flow could be positive or negative at any time period.

Net Present Value

Net Present Value Rule

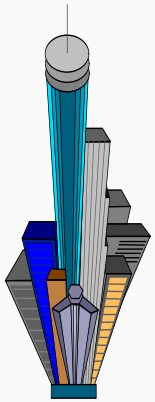
Managers increase shareholders' wealth by accepting all projects that are worth more than they cost.

Therefore, they should accept all projects with a positive net present value.

Net Present Value

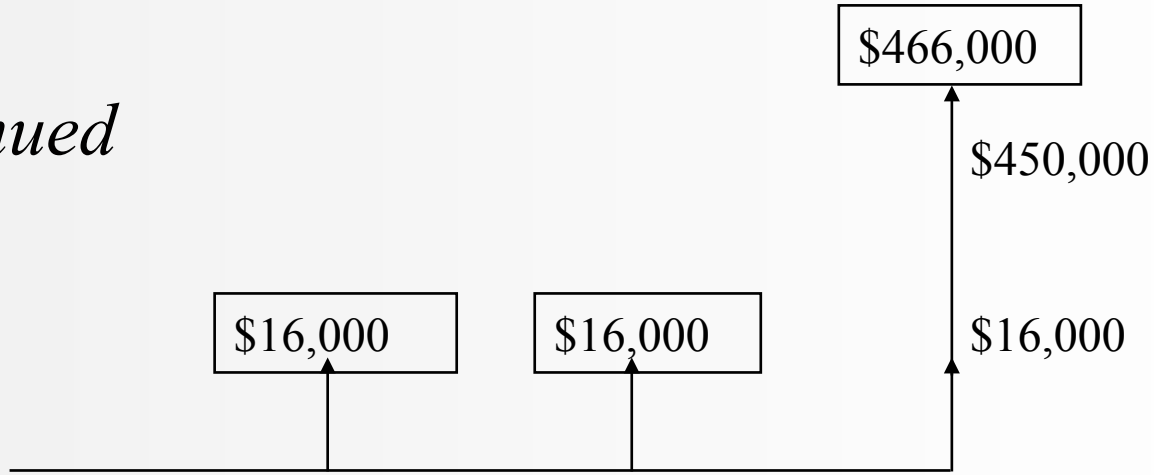
Example

You have the opportunity to purchase an office building. You have a tenant lined up that will generate $16,000 per year in cash flows for three years. At the end of three years you anticipate selling the building for $450,000. How much would you be willing to pay for the building?



Net Present Value

Example - continued



Present Value
14,953
14,953
380,395
$409,323

Net Present Value

Example - continued

If the building is being offered for sale at a price of $350,000, would you buy the building and what is the added value generated by your purchase and management of the building?

Net Present Value

Example - continued

If the building is being offered for sale at a price of $350,000, would you buy the building and what is the added value generated by your purchase and management of the building?

$$NPV = -350{,}000 + \frac{16{,}000}{(1.07)^1} + \frac{16{,}000}{(1.07)^2} + \frac{466{,}000}{(1.07)^3}$$

$$NPV = \$59{,}323$$

Payback Method

Payback Period - Time until cash flows recover the initial investment of the project.

➲ The *payback rule* specifies that a project be accepted if its payback period is less than the specified cutoff period. The following example will demonstrate the absurdity of this statement.

Payback Method

Example

The three projects below are available. The company accepts all projects with a 2 year or less payback period. Show how this decision will impact our decision.

	Cash Flows					
Project	**C_0**	**C_1**	**C_2**	**C_3**	**Payback**	**NPV@10%**
A	-2000	+1000	+1000	+10000	2	+ 7,249
B	-2000	+1000	+1000	0	2	- 264
C	-2000	0	+2000	0	2	- 347

Other Investment Criteria

Internal Rate of Return (IRR) - Discount rate at which NPV = 0.

Rate of Return Rule - Invest in any project offering a rate of return that is higher than the opportunity cost of capital.

$$\text{Rate of Return} = \frac{C_1 - \text{investment}}{\text{investment}}$$

Internal Rate of Return

Example

You can purchase a building for $350,000. The investment will generate $16,000 in cash flows (i.e. rent) during the first three years. At the end of three years you will sell the building for $450,000. What is the IRR on this investment?

Internal Rate of Return

Example

You can purchase a building for $350,000. The investment will generate $16,000 in cash flows (i.e. rent) during the first three years. At the end of three years you will sell the building for $450,000. What is the IRR on this investment?

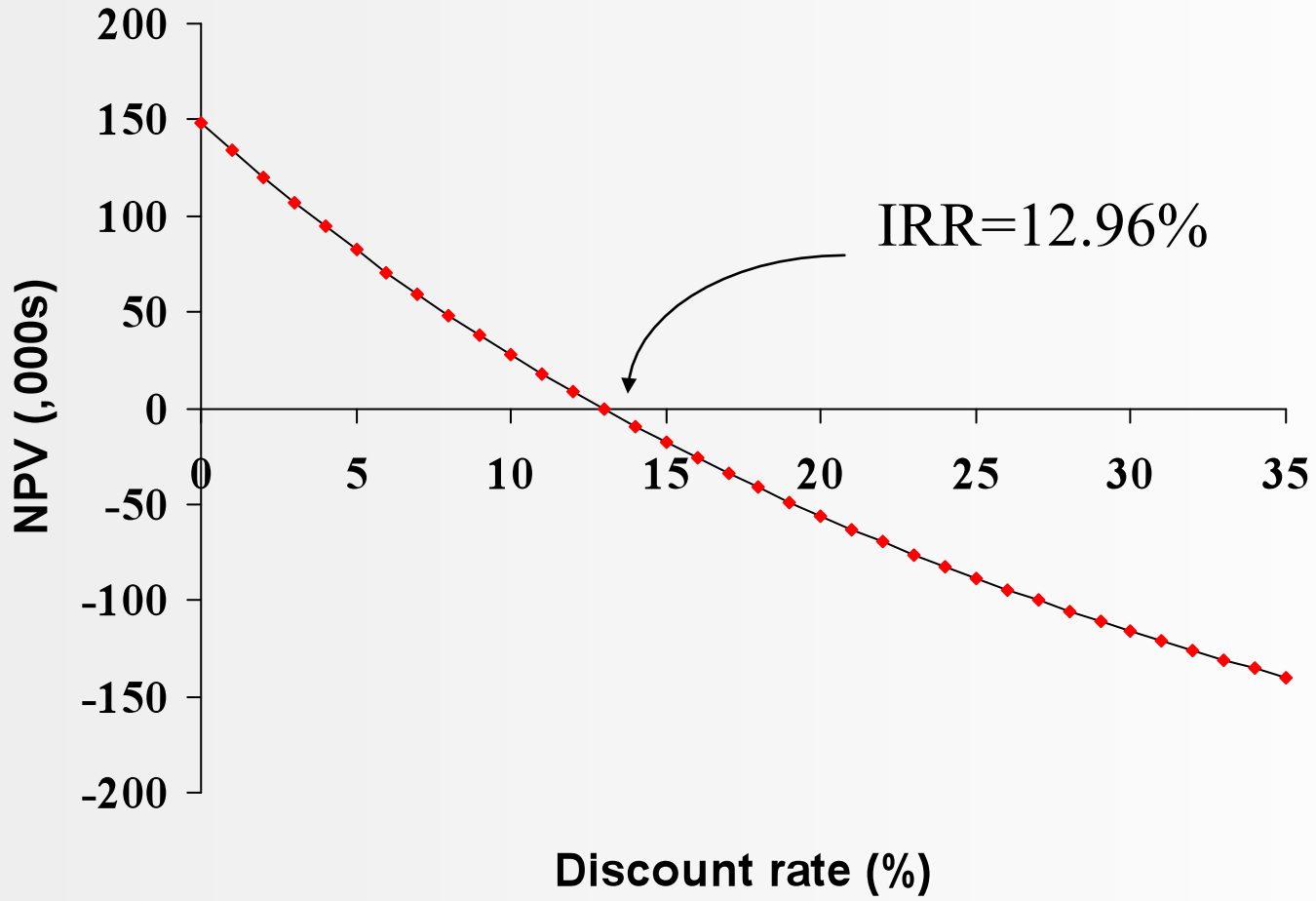
$$0 = -350{,}000 + \frac{16{,}000}{(1+IRR)^1} + \frac{16{,}000}{(1+IRR)^2} + \frac{466{,}000}{(1+IRR)^3}$$

IRR = 12.96%

Internal Rate of Return

	Calculating IRR by using a spreadsheet					
Year	**Cash Flow**				**Formula**	
0	(350,000.00)		IRR =	12.96%	=IRR(B3:B7)	
1	16,000.00					
2	16,000.00					
3	466,000.00					

Internal Rate of Return



Internal Rate of Return

Example

You have two proposals to choice between. The initial proposal (H) has a cash flow that is different than the revised proposal (I). Using IRR, which do you prefer?

$$NPV = -350 + \frac{16}{(1+IRR)^1} + \frac{16}{(1+IRR)^2} + \frac{466}{(1+IRR)^3} = 0$$

$$= 12.96\%$$

$$NPV = -350 + \frac{400}{(1+IRR)^1} = 0$$

$$= 14.29\%$$

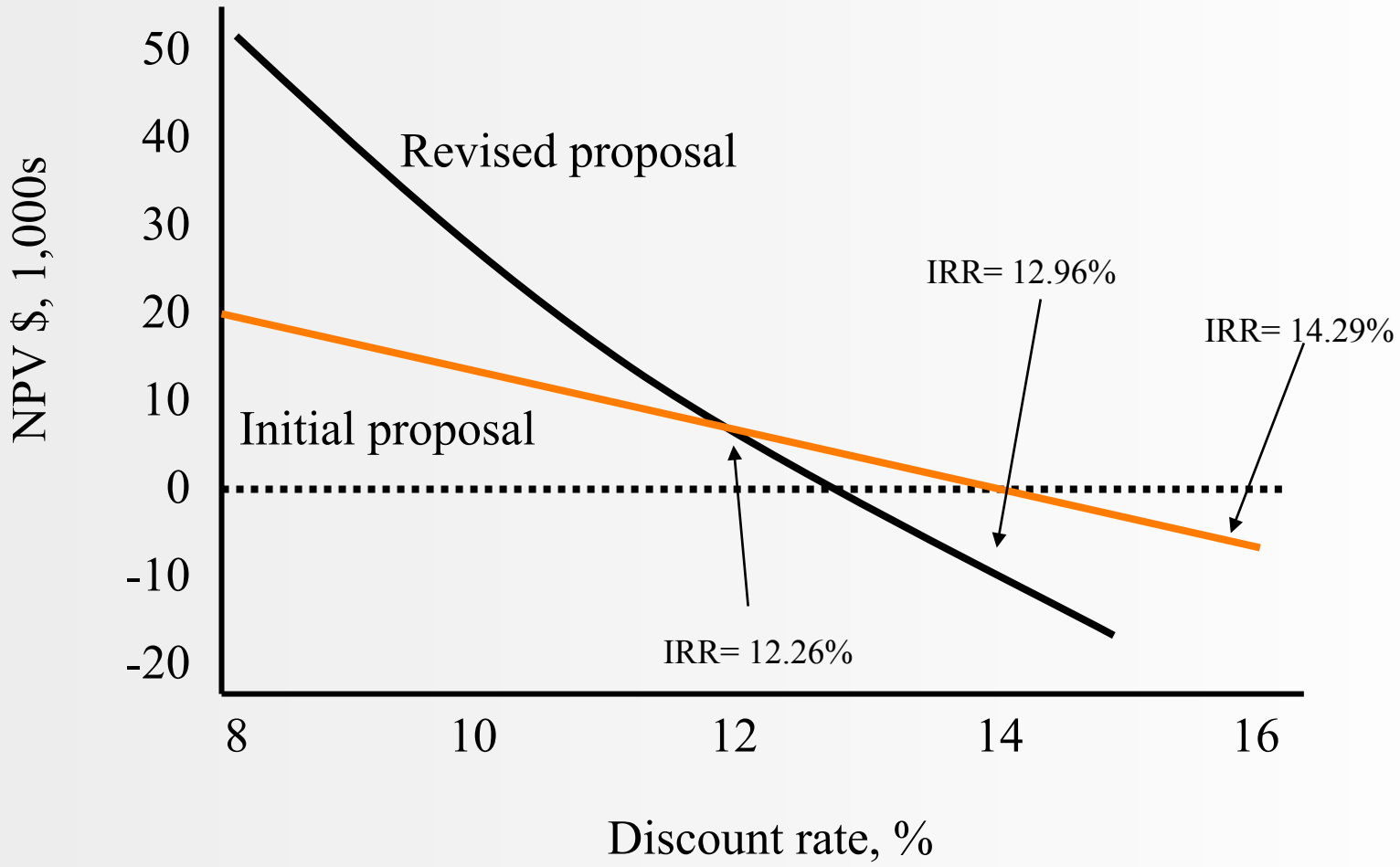
Internal Rate of Return

Example

You have two proposals to choice between. The initial proposal has a cash flow that is different than the revised proposal. Using IRR, which do you prefer?

Project	C0	C1	C2	C3	IRR	NPV@7%
Initial Proposal	-350	400			14.29%	$ 24,000
Revised Proposal	-350	16	16	466	12.96%	$ 59,000

Internal Rate of Return



Internal Rate of Return

Pitfall 1 - Lending or Borrowing?

- With some cash flows (as noted in textbook) the NPV of the project increases as the discount rate increases.
- This is contrary to the normal relationship between NPV and discount rates. (NPV Falls as discount rate rises.)

Pitfall 2 - Multiple Rates of Return

- Certain cash flows can generate NPV=0 at two different discount rates.

Pitfall 3 - Mutually Exclusive Projects

- IRR sometimes ignores the magnitude of the project.
- You cannot choose solely on IRR.

Project Interactions

When you need to choose between mutually exclusive projects, the decision rule is simple. Calculate the NPV of each project, and, from those options that have a positive NPV, choose the one whose NPV is highest.

Mutually Exclusive Projects

Example

Select one of the two following projects, based on highest NPV.

System	C_0	C_1	C_2	C_3	*NPV*
Faster	– 800	350	350	350	+ 118.5
Slower	– 700	300	300	300	+ 87.3

assume 7% discount rate

Investment Timing

Sometimes you have the ability to defer an investment and select a time that is more ideal at which to make the investment decision. A common example involves a tree farm. You may defer the harvesting of trees. By doing so, you defer the receipt of the cash flow, yet increase the cash flow.

Investment Timing

Example

You may purchase a computer anytime within the next five years. While the computer will save your company money, the cost of computers continues to decline. If your cost of capital is 10% and given the data listed below, when should you purchase the computer?

Investment Timing

Example

You may purchase a computer anytime within the next five years. While the computer will save your company money, the cost of computers continues to decline. If your cost of capital is 10% and given the data listed below, when should you purchase the computer?

Year	Cost	PV Savings	NPV at Purchase		NPV Today
0	50	70	20		20.0
1	45	70	25		22.7
2	40	70	30		24.8
3	36	70	34	**Date to purchase**	25.5
4	33	70	37		25.3
5	31	70	39		24.2

Equivalent Annual Annuity

Equivalent Annual Cost - The cash flow per period with the same present value as the cost of buying and operating a machine.

$$\text{Equivalent annual annuity} = \frac{\text{present value of cash flows}}{\text{annuity factor}}$$

Equivalent Annual Annuity

Example

Given the following costs of operating two machines and a 6% cost of capital, select the lower cost machine using equivalent annual annuity method.

	Year					
Mach.	1	2	3	4	PV@6%	E.A.A.
F	-15	-4	-4	-4	-25.69	- 9.61
G	-10	-6	-6		-21.00	-11.45

Equivalent Annual Annuity

Example (with a twist)

Select one of the two following projects, based on highest "equivalent annual annuity" (r=9%).

Project	C_0	C_1	C_2	C_3	C_4	NPV	EAA
A	−15	4.9	5.2	5.9	6.2	2.82	.87
B	−20	8.1	8.7	10.4		2.78	1.10

Capital Rationing

Capital Rationing - Limit set on the amount of funds available for investment.

Soft Rationing - Limits on available funds imposed by management.

Hard Rationing - Limits on available funds imposed by the unavailability of funds in the capital market.

Capital Budgeting Techniques

Investment Criterion	Percentage of Firms That Always or Almost Always Use Criterion	Average Score on 0–4 Scale (0 = never use; 4 = always use)		
		All Firms	Small Firms	Large Firms
Internal rate of return	76	3.1	2.9	3.4
Net present value	75	3.1	2.8	3.4
Payback period	57	2.5	2.7	2.3
Profitability index	12	0.8	0.9	0.8

Source: J. R. Graham and C. R. Harvey, "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics,* May 2001, pp. 187–243.